Nora Loose

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Research Interests

Physical & computational oceanography, Ocean mesoscale eddy parameterizations, North Atlantic-Arctic connectivity, Ocean observing system design, Adjoint modeling, Data assimilation, Uncertainty quantification

Education

01/2015 - 08/2019 **University of Bergen**, Bergen, Norway.
Ph.D. in **Physical Oceanography**
- Thesis: *Adjoint Modeling and Observing System Design in the Subpolar North Atlantic*
- Advisors: Kerim H. Nisancioglu (University of Bergen), Patrick Heimbach (UT Austin)
- Funded by European Research Council project ice2ice

04/2007 - 02/2013 **University of Bonn**, Bonn, Germany.
Diploma (equiv. M.Sc. degree) in **Mathematics**, **with Honors**
- Specialization: Stochastic Analysis; Minor: Physics
- Grade Point Average: 1.0, on a scale from 1.0 (excellent) to 4.0 (pass)

Research Experience

10/2020 - present **Postdoctoral Associate**, *Department of Applied Mathematics*, University of Colorado, Boulder.
- Member of the Ocean Transport and Eddy Energy Climate Process Team
- Improve ocean mesoscale eddy parameterizations via an energetically-consistent framework
- Mentor: Ian Grooms

09/2019 - 09/2020 **Postdoctoral Fellow**, *Oden Institute for Computational Engineering and Sciences*, University of Texas at Austin.
- Leveraged uncertainty quantification & data assimilation for ocean observing system design
- Mentor: Patrick Heimbach

1/2015 - 06/2018 **Graduate Researcher**, *Department of Earth Science*, University of Bergen, Norway.
- Investigated oceanic teleconnections in the North Atlantic, Nordic Seas, and Arctic Ocean
- Quantified uncertainties in ocean state estimates for present-day and paleoclimates

03/2013 - 08/2014 **Doctoral Research Fellow**, *Department of Mathematics*, ETH Zurich, Switzerland.
- Conducted research in the fields of Geometric Analysis and Partial Differential Equations
- Assisted in teaching undergraduate and graduate level courses

Teaching and Outreach

08/2020 **Science Communication**.
- Worked with Science Educator Annette deCharon to develop a ArcGis Story Map that explains adjoint modeling and a recent research article to a broader audience

02/2020 **Volunteer**, *Girl Day STEM Festival*, UT Austin.
- Hands-on science activities and demonstrations for elementary and middle school students

03/2013 - 08/2014 **Teaching Assistant**, *Department of Mathematics*, ETH Zurich, Switzerland.
- Taught 3 graduate level math courses (*Measure Theory & Integrals, Differential Geometry I, II*)
- *Teaching evaluations*: 4.8 (2013), 4.9 (2014) on a scale from 1 (very bad) to 5 (excellent)

07/2013 **Teaching Assistant**, *PCMI Graduate Summer School*, Park City, UT.
- Taught advanced math course (*Weak immersions of surfaces with L^2-bounded second fundamental form*, lecture notes) for Ph.D. students and postdocs

10/2008 - 02/2013 **Teaching Assistant**, *Department of Mathematics*, University of Bonn, Germany.
- Taught 3 undergraduate level math courses (*Mathematics for Physicists I, Analysis II, III*)

01/2010 - 04/2010 **Teaching Assistant**, *Department of Mathematics*, University of Toronto, Canada.
- Taught undergraduate level math course (*Linear Algebra*)

2009 - 2011 **Student Assistant**, *Hausdorff Center for Mathematics*, University of Bonn, Germany.
- Organized and led math outreach events for students from elementary and secondary school

Professional Service

Peer review service

since 2020 Geophysical Research Letters

Review of proposals

since 2020 Panelist for reviewing NASA ROSES proposals

Organization of Conferences

04/2017 Co-Convener for the session "Quaternary climate archives and proxy uncertainty", EGU General Assembly 2017.

09/2015 Co-Organizer of PhD conference "Connecting the ocean, atmosphere and ice sheets", 20 participants, Denmark.

Awards and Scholarships

04/2019 **Rising Stars in Computational & Data Sciences**, *Oden Institute for Computational Engineering and Sciences*, University of Texas at Austin.
- Selected for competitive, international career event for women in Computational & Data Sciences

03/2018 **Best Presentation Award**, *Research School on Changing Climates in the Coupled Earth System*, Sommarøy, Norway.

02/2016 **Research Grant**, *Norwegian Research School in Climate Dynamics*, NOK 20,000, for research stay at MIT.

02/2013 **Award "Diploma with Honors"**, *Department of Mathematics, University of Bonn, Germany*, for graduating with highest possible grade point average.

2008 - 2012 **German Academic Scholarship Foundation Award**, *Studienstiftung des deutschen Volkes*, for outstanding academic achievements (given to 0.5% of students in Germany).

2006 **3 Awards**, *for exceptional results in high-school final exams on state-wide basis*.
- *Porsche AG*: for excellent performance in mathematics and physics
- *German Physical Society*: for excellent performance in physics
- *Reinhold Beitlich Foundation*: for exceptional overall performance

Publications

Journal Arcticles

J1 Y. Fujii, E. Rémy, H. Zuo, P. Oke, G. Halliwell, F. Gasparin, M. Benkiran, **N. Loose**, J. Cummings, J. Xie, Y. Xue, S. Masuda, G.C. Smith, M. Balmaseda, C. Germineaud, D.J. Lea, G. Larnicol, L. Bertino, A. Bonaduce, P. Brasseur, C. Donlon, P. Heimbach, Y. Kim, V. Kourafalou, P-Y. Le Traon, M. Martin, S. Paturi, B. Tranchant and N. Usui. Observing System Evaluation Based on Ocean Data Assimilation and Prediction Systems: On-Going Challenges and a Future Vision for Designing and Supporting Ocean Observational Networks, *Front. Mar. Sci. 6:417*, 2019. doi: 10.3389/fmars.2019.00417.

J2 **N. Loose**, P. Heimbach, H. Pillar and K.H. Nisancioglu. Quantifying Dynamical Proxy Potential through Shared Adjustment Physics in the North Atlantic. *Journal of Geophysical Research: Oceans 125, no. 9*, 2020. doi: 10.1029/2020JC016112. Selected as Eos Research Spotlight.

Preprints

P1 **N. Loose** and P. Heimbach. Leveraging Uncertainty Quantification to Design Ocean Climate Observing Systems, *Submitted.* doi: 10.1002/essoar.10504562.1.

Thesis

T1 **N. Loose**. Adjoint Modeling and Observing System Design in the Subpolar North Atlantic, *Ph.D. Dissertation*, University of Bergen, 2019. http://bora.uib.no/handle/1956/24456.

Presentations

Invited Talks

06/2020 **IARPC Joint Modeling-Arctic Observing Systems Sub-Team Meeting**, *Online*.
Looking at observing systems through the lens of models: Targeted Observations

04/2018 **EGU General Assembly 2018 (solicited)**, *Vienna, Austria*.
How informative are SST proxy data in paleoceanographic inverse modeling?

03/2018 **Northumbria University**, *Newcastle, UK*.
Uncertainty Quantification and Constraints on Subsurface Heat Content at Greenland's Margins

Selected Conference Presentations

02/2020 **Ocean Sciences Meeting 2020**, *San Diego, CA*.
The Dynamical Proxy Potential of the OSNAP Array

10/2018 **ECCO Meeting**, *Austin, TX*.
Comprehensive Observing System Design within the ECCO Framework

07/2018 **Workshop on Sensitivity Analysis and Data Assimilation in Meteorology and Oceanography**, *Aveiro, Portugal*.
Uncertainty Quantification as a Tool for Observing System Design - An Oceanographic Perspective

06/2018 **Adjoint (TACOMA) Workshop**, *Oxford, UK*.
Adjoints as a Tool for Observing System Design

Selected Poster Presentations

06/2017 **Data Assimilation Workshop**, *Bergen, Norway*.
How Informative are Paleoceanographic Observations for an Inverse Problem?

05/2017 **Past Global Changes (PAGES) Workshop**, *Louvain-la-Neuve, Belgium*.
How Informative are Paleoceanographic Observations for an Inverse Problem?

03/2017 **Workshop on Emerging Applications of Data Assimilation in the Geosciences**, *Leiden, Netherlands*.
Uncertainty Quantification for Adjoint-Based Data Assimilation with Sparse Data

Selected Courses

Oceanography & Climate

02/2016 **Large Scale Turbulence in Atmosphere and Ocean**, *Instructor: Joe LaCasce*, University of Oslo, Norway.
2D turbulence, 3D turbulence, geostrophic turbulence, turbulent diffusion.

08/2015 **Advanced Climate Dynamics Courses (ACDC) summer school**, Laugarvatn, Iceland.
Topics in oceanography, glaciology, geology, meteorology.

Spring 2015 **Paleoceanography**, University of Bergen, Norway.
Modes and instabilities of ocean circulation during warm climate states.

Modeling

Fall 2016 **Introduction to Ocean Modeling**, *Instructor: Patrick Heimbach*, UT Austin, TX.
Conservations laws, approximations, discretization, parameterization schemes, adjoint modeling.

07/2016 **Modeling of the Arctic Climate System**, IARC Summer School, University of Alaska Fairbanks, USA.
Modeling of ocean, sea ice, glaciers, permafrost, clouds, cyclones, atmospheric and ocean chemistry, vegetation, marine ecosystem, forest fires, floods, downscaling techniques, Arctic amplification.

11/2015 **HPC Course**, University of Bergen, Norway.
High-Performance Computing (HPC), MPI and OpenMP programming, build systems, revision systems, debugging.

Spring 2015 **Numerical Modeling**, University of Bergen, Norway.
Finite difference methods, explicit and implicit schemes, staggered grids and time steps, stability analyses, relaxation methods for boundary value problems, flux limiter and TVD schemes.

Data Assimilation & Uncertainty Quantification

Fall 2017 **Computational methods for inverse problems**, *Instructor: Omar Ghattas*, UT Austin, TX.
Theory and numerical solution of PDE-constrained inverse problems.

06/2017 **Crash Course on Data Assimilation - Theoretical foundations and advanced applications with focus on ensemble methods**, NERSC, Bergen, Norway.
EnKF, data assimilation for climate prediction and chaotic dynamics, model error, particle filters.

06/2015 **Introduction to Uncertainty Quantification**, *Instructors: Youssef Marzouk, Luis Tenorio*, Institute for Mathematics and its Applications, University of Minnesota, MN.
Bayesian statistics, uncertainty quantification, model validation, model reduction, MCMC methods.

Mathematics

2010/11 **Stochastic Analysis**, University of Bonn, Germany.
Martingales, Stochastic integrations, Ito calculus, Stochastic differential equations.

2009 **Stochastic Processes**, University of Bonn, Germany.
Gaussian processes, Markov processes, Gibbs measures, Random walks, Brownian motion.

Field Work

07/2017 - 08/2017 **East Greenland Ice-Core Project (EastGRIP)**, *Greenland*.
- Drilled shallow ice cores, conducted surface measurements and lab work in the science trench

08/2016 - 09/2016 **G.O. Sars**, *Irminger Sea*.
- Collected physical oceanographic data and marine sediment cores for the ice2ice project (ERC)

Skills

Programming

- Python, MATLAB, Fortran, Unix/Linux, Git, LaTeX.

Languages

- *Fluent in:* German, English, Norwegian; *Basic knowledge in:* Spanish, Italian.